

KANSAS SOYBEAN SEED SURVEY, 1978

by

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B.A., Saint Mary of the Plains College
Dodge City, Kansas 1977

A MASTER'S THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY
Manhattan, Kansas
1979

Approved by:

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ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Dr. Cecil Nickell for his assistance and guidance during the program of study.

Many thanks to Dr. R. Vanderlip (Agronomy) and Dr. F. W. Schwenk (Plant Pathology) for serving on the advisory committee.

Special thanks to Dr. W. T. Schapaugh (Agronomy) for his help during the manuscript preparation.

Thanks to L. A. Burchett, Kansas Crop Improvement Association, Carol Webster, Kansas State Seed Testing Laboratory, M. E. Johnson, Kansas Crop and Livestock Reporting Service, and the Soybean project crew for all the assistance they gave.

The author is indebted to the Department of Agronomy, Kansas State University, for supplying facilities, materials, and support for this research.

A very, very special thanks to Pauline M. Lubbers for the personal support given and to George J. Lubbers whose memory has been a very great inspiration in the author's course of study.

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INTRODUCTION AND REVIEW OF LITERATURE

Production of soybeans (Glycine max (L.) Merrill) is important throughout the United States. In Kansas, harvested soybean acres have increased 46% from 0.99 million acres in 1977 to 1.48 million acres in 1978 (12). Some factors that influence soybean production can be controlled. These include soil fertility, cultivar selection, and seed quality. Soil moisture, in some areas, can be controlled by irrigation. With the increase in the cost of producing soybeans, it is important to plant the highest quality soybean seed available to reduce risks. Knowledge of the seed quality and related production practices can be useful to agencies that advise farmers as well as the industries and programs that deal with soybeans in Kansas.

Few seed surveys have been conducted. Georgia (17) and South Carolina (7) conducted drill box surveys to determine quality and kind of small grain seed being planted by farmers in their states. Samples were taken for laboratory analysis and demonstration plots. The demonstration plots were planted to show the general public the kind and quality of small grain seed that was being used in production. They concluded that homegrown seed was of the poorest quality.

In Nebraska (16), a survey indicated that certified seed of new, better adapted wheat cultivars gave higher yields than uncertified seed of older, less adapted cultivars, but these results were from an unreplicated test.

An oat seed survey was conducted in Wisconsin (3). Samples and questionnaires were obtained by extension agents from farmers' oat fields planted near the road. Four or five different counties were sampled each year during a three year period. Part of each sample

was sent to the Wisconsin State Seed Laboratory for analysis and part was grown in field trials. It was concluded that oat seed in Wisconsin should be cleaned more thoroughly. Farmers and operators of seed cleaning plants should be made aware of and be able to identify good quality seed. Operators of seed cleaning plants should be instructed in proper use of seed cleaning equipment.

In India (21), a wheat seed survey was conducted to relate the seed quality to certification standards set for wheat seed. Most of the seed lots did not meet minimum standards.

Another wheat seed survey was completed in Kansas (8) in 1974. Seed lots and questionnaires were collected from each area of the state, proportionate to the number of wheat farmers in each area. A sample of each seed lot was laboratory analyzed and another sample of each seed lot was field tested for cultivar purity. No significant differences were noted in yields after cultivar differences were removed. Approximately half of the samples had some type of cultivar impurity. Certified classes of seed and recently released cultivars were genetically more pure than homegrown seed or older cultivars.

A soybean seed survey in a three county area in Iowa (15) was conducted over a two year period. Seed lots and questionnaires were obtained from the farmers by survey personnel during the planting period. Lots sent to Ames, Iowa were analyzed for cultivar identification, germination and cleanliness. Most of the soybean seed was homegrown, mixed as to cultivar, low in mechanical purity, high in weed and other crop seeds, and high in germination.

This soybean survey was conducted to evaluate the quality of soybean seed planted in Kansas and to determine, along with related

factors in production, the importance of the prevalent soybean seed quality.

MATERIALS AND METHODS

The number of seed samples and questionnaires requested in Kansas, was determined by the following criteria:

- 1) one sample per county, plus
- 2) one sample per 60 soybean farmers, plus
- 3) one sample per 6,000 acres of soybeans.

A total of 417 samples were requested to be collected by county agricultural agents based on 1976 estimates of soybean acreages (11). County agents were asked to collect samples in their county from a given number of soybean farms, place 2.5 kg of soybean seed in a container, and record answers on the questionnaires (Fig. 1). The number of samples from each county was based on the same three criteria as used for the state total and the total number of samples requested from all counties was required to equal the state total of 417 samples. Two additional criteria were used in the collection method as the county agents conducted the survey:

- 4) one sample of double crop soybeans on each farm sampled, plus
- 5) one sample of each cultivar planted on every fourth farm sampled.

Samples were collected on 15 June and 5 July, 1978, to allow sampling as close to planting as possible. Of the 417 requested samples, 379 questionnaires and seed lots were received from the county agents. The samples were coded by crop reporting district, cooperative extension district, county, farm within county, and sample within farm. Kansas is divided into nine crop reporting districts (CRD)(Fig. 2) and five cooperative extension districts (CED)(Fig. 3). The CRD's were then grouped by regions: east, central, and west. These districts were used

SURVEY FORM
1978 KANSAS SOYBEAN SEED SURVEY

(one form to be filled out for each sample taken)

1. Identification number _____
(Three part number must match number on sample bag)
2. Variety planted _____
3. Acres planted with this seed _____
Irrigated _____ acres; Dryland _____ acres
4. Total farm acres soybeans _____
5. Other varieties planted this year _____
6. Seed Source Home grown _____ Another farmer _____ Dealer _____
7. Seed Treatment Fungicide Yes _____ No _____ Don't know _____
Inoculant Yes _____ No _____ Don't know _____
8. Was soil tested? Yes _____ No _____ pH _____ P _____ K _____
9. Fertilizer application (actual or expected) lbs/a N _____ P_2O_5 _____ K_2O _____
10. Herbicide application (actual or expected) Yes _____ No _____
What herbicide _____
11. Was seed cleaned? Yes _____ No _____
If cleaned -- At home _____ Another farmer _____ Commercial _____
If not cleaned at home -- how many miles to cleaner _____
12. Seeding rate _____ lbs/acre Row width _____
13. Seeding date (actual or expected) _____
Double-cropping Yes _____ No _____ Previous crop _____
14. Was seed laboratory tested? Yes _____ No _____
Reported germination _____ Purity _____ Inert _____
15. Is this seed: Certified _____ Registered _____ Foundation _____
(send analysis tag, if possible)
16. If not certified, registered or foundation, number of years away from
certified seed _____.

* * * * *

Samples to be gathered and analyzed at State Seed Laboratory

* * * * *

Figure 1. Questionnaire used to collect information on seed history, planting practices, and production conditions.

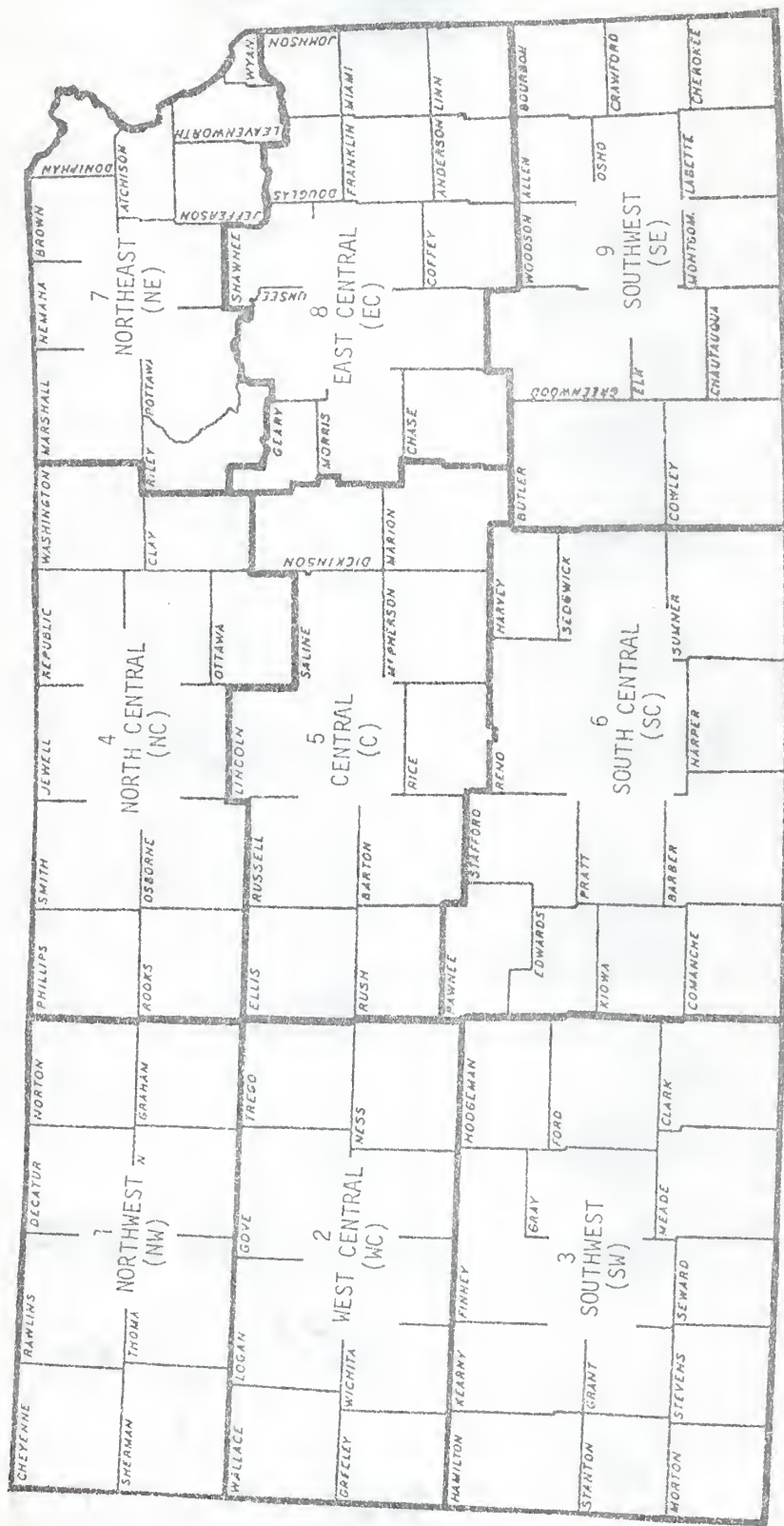
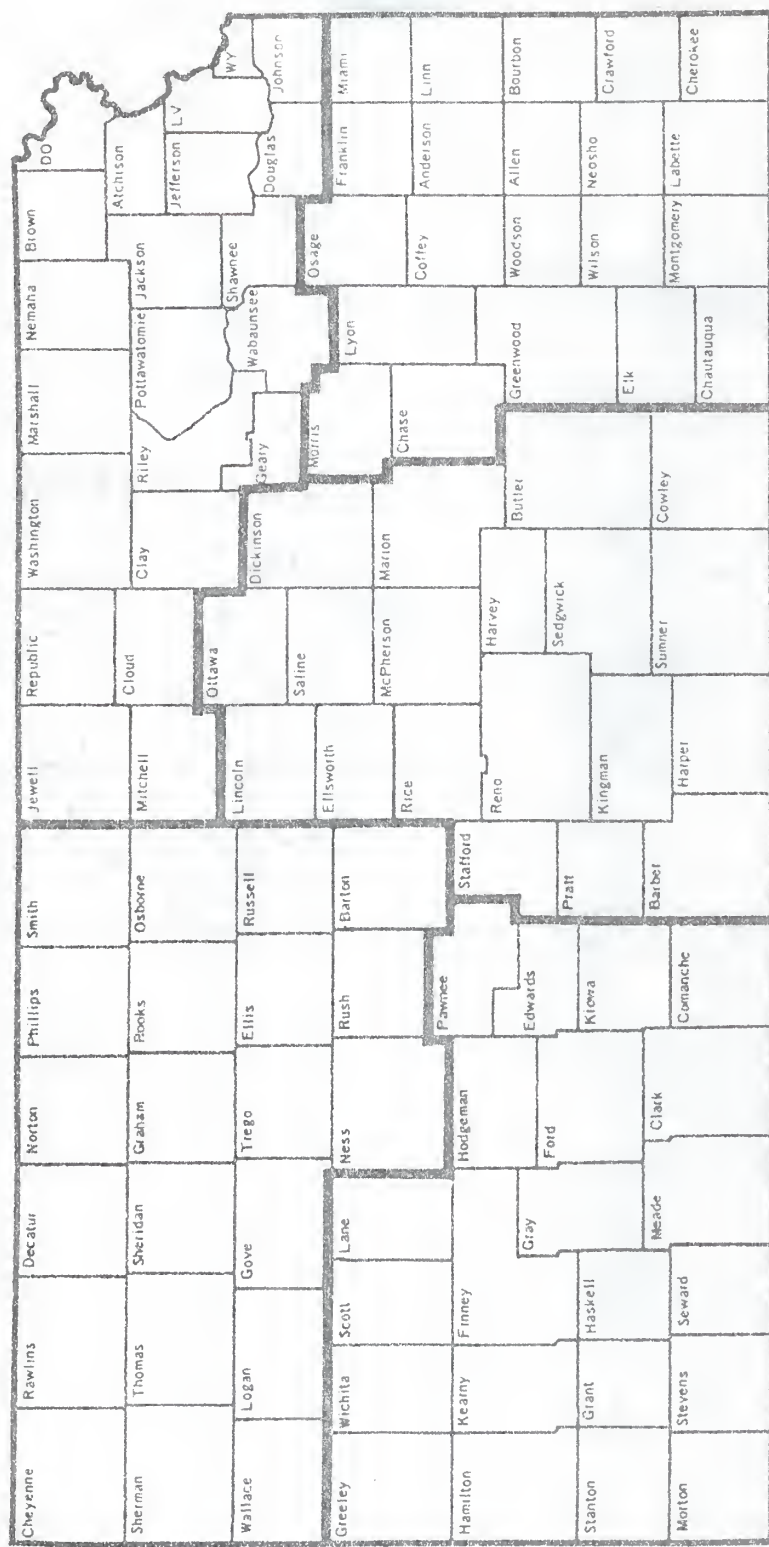


Figure 2. Kansas is divided into nine Crop Reporting Districts (CRD).

(NW) NORTHWEST (1)

(NE) NORTHEAST (4)



(SW) SOUTHWEST (2)

(SC) SOUTH CENTRAL (3)

(SE) SOUTHEAST (5)

Figure 3. Kansas is divided into five Cooperative Extension Districts (CED).

for convenience in compiling and presenting statistical information. The data was summarized by districts.

A seed sample of 650 grams from each seed lot and a control for each cultivar was sent to the Kansas State Seed Testing Laboratory for the 'full test' and the 'soybean stress test' (9). The 'full test' included a standard laboratory warm germination, mechanical purity, inert matter, weed seed content, other crop seed content, and the kind and number of Kansas noxious weed seeds. The 'soybean stress test' is an accelerated aging test. Figure 4 shows an example of the test reports.

Seed lots were scored from 1 to 5 with 1 representing no seed coat mottling, no greenseededness, no split or broken seeds, or excellent seed quality while 5 represented the opposite end of the range. Seed weight is reported as grams per 200 seeds. Seed was also visually checked to determine cultivar purity by observing hilum color and seed coat luster.

A yield test of the most commonly reported cultivar, 'Williams', was planted 23 June, 1978 at Ashland Research Farm, Manhattan, Kansas. One-hundred seed lots were chosen at random from the first group of samples received. Plots were arranged in a randomized, complete block design with two replications. A volume equivalent to 200 randomly selected whole seed from each sample was used to obtain material (seeds, inert matter, plus any other material) for planting in the yield test. A planting density of 430,600 seeds per hectare occurred if the sample consisted of only whole seeds (5). Plots were 6.1 m long with 4 rows spaced 76 cm apart. Plots were irrigated as needed during the growing season.

SEED LABORATORY

2524 West Sixth Street
TOPEKA, KANSAS 66606

Lab. No. 8637 Submitted as nn Soybeans
Lot No. 390350301*
Received 6-20-78 Reported 7-7-78
Sent in by KCIA Drillbox
Address

REPORT OF EXAMINATION

Reported as * Soybeans

Germination	91.0	%	Hard Seed	00	%
Purity	82.39	%	Weed Seed	.01	%
Inert	17.59	%	Other Crop Seed	.01	%

Name and number Noxious weed seed per pound:

none

Seed testing charge: AA 72%

Supervisor, State Seed Laboratory.

For schedule of seed testing charges write State Seed Laboratory.

Any agricultural seed shall be deemed mislabeled within the meaning of the act if there appears on the label, container, invoice, other accompanying literature, or any advertising media, any statement directly or indirectly implying that any agricultural seed is recommended, tested or endorsed by the Kansas State Board of Agriculture or its State Seed Laboratory, or any of its other divisions.

* The variety of a number of crops cannot be determined by examination of the threshed seed, therefore, such seeds are reported by the crop designation. The owner, if certain of the variety, may label as to variety name.

Fig. 4. A sample laboratory report prepared by the Kansas State Seed Test Laboratory.

To evaluate field emergence and cultivar purity, all 379 samples were planted in a field test next to the yield test. The test was arranged in 6.1 m single row plots with 430,600 seeds per hectare, 76 cm apart (5). Plots were arranged in a randomized, complete block design with two replications. The only restriction on randomization within blocks was that the samples of the reported cultivar were planted together. Seed used for seed weight measurements were used to evaluate field emergence and cultivar purity.

In both the yield test and the field test, emergence counts were taken when 90-95% of the plants had their first trifoliolate leaf. Environmental conditions at planting were sufficient for emergence. Flower color was noted. Maturity and pod and pubescent color were recorded at harvest time. In the field test, because of an early frost, maturities were rated from 1 (harvestable) to 5 (completely green). In the yield test, maturity of each plot was relative to Williams control plots. Maturity differences were used to determine misidentified cultivars. Yield plots were trimmed at maturity to 4.9 m and harvested. Harvested soybeans were cleaned, weighed (g/plot), and weights adjusted to 13% moisture content.

Interrelationships between field test and yield test emergence and the items measured by the Kansas State Seed Testing Laboratory, the visual seed scores, seed weights, and the farmer's seed populations, using product-moment correlations, were noted. Data from the field test and the yield test were analyzed separately. An analysis of covariance was performed on the seed yields with emergence percentage, flower color offtype percentage, and pod and pubescent color offtype percentage as multiple covariates.

Seed lots were compared with Kansas minimum seed standards for soybean seed certification (Table 1)(10). Two modifications were needed to make the comparisons. Seed lots were labeled 'correctly identified', 'mixed', and 'incorrectly identified' as to reported cultivar. The amount of cultivar contaminants in the seed that was assumed acceptable was modified to 2% because of possible seed handling problems during sample shipment. A mixed sample had seed that was 2-98% of another cultivar than the one reported. Incorrectly identified samples had seed that was 98 to 100% of another cultivar. A blend was correctly identified if the characteristics of the components were identified. For the second modification, data for weed seed content and other crop seed content was expressed as a percentage by weight. Since certification standards are expressed as number of seeds by weight, it was assumed that samples that contained any weed seeds or other crop seeds did not meet certification standards.

A t-test was used to compare crop reporting district (CRD) means of standard laboratory germination, accelerated aging, field test emergence, mechanical purity, seeding rates, and seed populations to discern any trends or differences from district to district (22).

Table 1. Minimum seed standards for soybean certification in Kansas.

Soybean seed shall meet the following requirements for certification:

Mechanical purity- - - - -	-98.00%
Inert matter (maximum) - - - - -	2.00%
Weed seed (maximum)- - - - -	10 seeds/lb
Noxious weed seed - - - - -	None
Objectionable weed seed - - - - -	None

For example:

Bullnettle or horsenettle	Morningglory
Cocklebur	Shattercane
Giant ragweed	Sunflower
Hedge or hairy bindweed	Velvetleaf

Other crop seed

Corn and grain sorghum- - - - -	1 seed/lb
All other crops - - - - -	3 seeds/lb
Other cultivars- - - - -	.1%
Germination (minimum)- - - - -	80.00%

RESULTS AND DISCUSSION

In general, the distribution of the samples collected in the survey corresponded well with the soybean acreage in each district (Fig. 5), however more samples were needed from CRD 6 and 8. Data from CRD 1 and 2 are based on relatively few samples so false impressions may result if they are used without the information collected from the rest of the state.

SEED QUALITY

Clean, vigorous seed of a known cultivar is a goal for high quality seed. Laboratory tests to determine cleanliness and vigor of the seed samples are presented in Table 2.

Weed seed and other crop seed contents together averaged only 0.03% by weight. Therefore, the split and broken seed score and inert matter were indirect measures of mechanical purity. Mechanical purity is the percentage of whole seeds by weight. Pure live seed, seed that is viable and will germinate, is a function of mechanical purity and germination and is a measure of seed quality (24). CRD means of mechanical purity, as well as germination, accelerated aging, and field emergence, were not significantly different and showed no trends across Kansas.

Weeds and other crop plants affect the yield of soybeans by competition during the growing season (20). Weed seeds and other crop seeds should be removed from soybean seed. Bur ragweed (Fanseria tomentosa and F. discolor), a noxious weed seed, was identified in only one sample. Noxious weed names are listed in

% of state acreage -- (5)†	0.11	% of state acreage -- (12)	2.26	% of state acreage -- (78)	18.64
% of state samples --	0.92	% of state samples --	2.08	% of state samples --	20.75
	1		4		7
% of state acreage -- (6)	0.24	% of state acreage -- (16)	1.95	% of state acreage -- (104)	30.68
% of state samples --	0.67	% of state samples --	4.23	% of state samples --	21.61
	2		5		8
% of state acreage -- (15)	0.91	% of state acreage -- (17)	6.00	% of state acreage -- (126)	39.63
% of state samples --	1.43	% of state samples --	3.30	% of state samples --	44.99
	3		6		9

† Numbers in parentheses are numbers of samples from indicated CRD's.

Fig. 5. Stylized map of Kansas showing percentages of total state soybean acres, (based on 1978 county estimates from Kansas Crop and Livestock Reporting Service), number of samples, and percentages of statewide samples, respectively, for each CRD.

Table 2. Laboratory tests for seed quality and actual field emergence.

	Mean	Std. dev.	Range
<hr/>			
	<hr/> %		
Yield test emergence	55.9	11.3	23.6 - 75.4
Field test emergence	65.6	12.1	2.8 - 86.2
Standard warm germination	87.5	9.5	16 - 97
Accelerated aging	62.7	25.4	0 - 93
<hr/>			
	<hr/> % by weight		
Mechanical purity	97.10	4.16	66.59 - 99.96
Inert Matter	2.87	4.12	0.04 - 33.34
Weed seed content	0.02	0.07	0.00 - 0.93
Other crop seed content	0.01	0.04	0.00 - 0.43
<hr/>			
	<hr/> score†		
Seed quality	2.2	0.5	1.3 - 3.5
Greenseededness	1.4	0.6	1.0 - 4.5
Mottling of seed coat	1.3	0.5	1.0 - 4.0
Split and broken seeds	1.7	0.5	1.0 - 4.5
<hr/>			
	<hr/> grams per 200 seeds		
Seed weight	33.9	5.60	20.48 - 45.58
<hr/>			
	<hr/> number		
Noxious weed seed	1.9	10.6	0 - 140

† Scale: 1, excellent, to 5, poor.

Table 1. Morningglory (Ipomoea spp.) and horsenettle (Solanum carolinense) were the only objectionable weed seeds found in the samples. Morningglory was the worst weed problem.

Poor visual seed quality scores indicated poor seed lots. Greenseededness and mottling of the seed coat were highest in CRD 9 but similar in the other CRD's.

Only 4.5% of the samples were incorrectly identified by the farmers and 83.4% of the samples were correctly identified, with the rest of the samples mixed. Hilum color and seed coat luster were not useful criteria to determine cultivar purity. A clear division between imperfect black hila and black hila and between shiny and dull seed coats was not apparent. Many cultivars have the same hilum color and seed coat luster. The use of flower, pod, and pubescent color proved to be the best characteristics to evaluate cultivar identification.

The percentage of samples that passed all certification standards may be over critical of soybean seed quality (Table 3). Most samples could have met certification standards if thoroughly cleaned. Mechanical purity, inert matter, weed seed content, and other crop seed content can be improved by cleaning. Seed contaminated by another cultivar can not be easily restored. Increased planting rate can compensate for germination percentages slightly below certification standards.

Standard warm germination and accelerated aging test results were good indicators of field emergence (Table 4). Tests for mechanical purity were also indicators of field emergence but the correlations were not as great. Farmers should use either or both the standard warm germination and accelerated aging with a mechanical purity test to determine if they should plant a particular seed lot. Adjustments

Table 3. Comparisons of seed samples to certification standards.

	Total	Non-certified	Certified
	<hr/>		
		<hr/>	
		% passed	
Mechanical Purity	59.9	56.6	75.0
Inert Matter	60.2	56.9	75.0
Weed Seed	78.6	75.7	94.4
Noxious or objectionable weed seeds	85.0	81.9	98.6
Corn or Grain Sorghum seed (None)†	78.1	74.7	93.1
All other crop seed (None)†	78.1	74.7	93.1
Other cultivars (<2%)‡	83.4	82.6	88.5
Germination (<80.00%)	86.3	86.1	86.1
	<hr/>		
Met all standards	37.2	31.3	52.5

† certification standards are number of seeds per lb and the data is in percent by weight so it is assumed that if the samples have none of these seeds present, it would pass.

‡ modified because of possible mixing in shipping.

Table 4. Laboratory tests correlated with emergence.

<u>Laboratory Test</u>	<u>Emergence</u>	
	<u>Field test</u>	<u>Yield test</u>
	--correlation coefficient--	
Standard warm germination	+0.70***	+0.66***
Accelerated Aging	+0.54***	+0.64***
Mechanical purity	+0.11*	+0.47***
Inert Matter	-0.11*	-0.46***
Weed seed content	-0.03	-0.19
Other crop seed content	-0.13*	-0.26**
Noxious weed seed number	-0.03	-0.21*
Seed weight/200 seeds	+0.01	+0.05
Seed quality score	-0.20***	-0.31**
Greenseededness score	+0.03	+0.19
Mottling of the seed coat score	-0.14*	+0.07
Split and broken seed score	-0.16**	-0.49***

*,**,*** Significant at 5%, 1%, and .1% levels, respectively.

can be made in seeding rate to compensate for low seed germination and low mechanical purity.

No significant differences were detected among the yields in the yield test of Williams (Table 5), although differences in cultivar purity and field emergence were identified. Cultivar purity ranged from correctly identified to incorrectly identified as indicated by maturities two weeks earlier to five days later than the Williams checks. Emergence ranged from 23.6% to 75.4%. The plant populations ranged from 101,600 plants per hectare (2.4 plants per row foot in 30-inch rows) to 325,000 plants per hectare (7.6 plants per row foot in 30-inch rows), respectively. A plant population between 71,800 plants per hectare and 129,200 plants per hectare is necessary to produce a significant yield reduction (9,18). It is possible that the plant populations were not low enough to cause a yield decrease. There was considerable variation in yield throughout the yield test. Soybeans can compensate for row skips, defoliation and thinning (2,4,23).

Table 5. Analysis of covariance of yields in Williams yield plots.

Source of variation	d.f.	Mean square
Samples	99	43802.8 ns
Replications	1	5469765.0***
Error	96	69854.9

*** Significant at the .1% level.

RELATED PRODUCTION PRACTICES

Production practices affect the soybean crop as does seed quality. The production practices were presented to complement the seed quality information and to evaluate the anticipated handling of the soybean seed by the farmers.

Williams was the predominant cultivar reported in the survey (Table 6), followed by Columbus and Clark(s). The six most common cultivars accounted for 75.8% of the total samples. The total number of cultivars and blends was 30 of which 78.3% of the samples, excluding blends, were cultivars released since 1970. This indicated that most farmers used newer, more productive cultivars.

The distribution of cultivars planted throughout the state corresponded with the areas where they are better adapted (Fig. 6). Williams was the most widely grown cultivar in each CRD, except the northwest and the southeast. Cultivars of Williams' maturity generally mature too late for northwest Kansas. In southeast Kansas, cultivars that mature later than Williams, such as Columbus or Forrest, often produce higher yields than earlier maturing cultivars. This is accomplished by delaying the reproductive growth until rainfall is more favorable.

The acres planted per soybean cultivar averaged 140.3 acres with a standard deviation of 155.2 acres. There was a tendency for the acreage planted to a given cultivar to increase from the west to the east (Table 7).

Total soybean acres per farm increased from the northwest to the southeast (Fig. 7). Environmental conditions for dryland soybean production are generally more favorable in the east, shown by larger

Table 6. Soybean cultivars planted in Kansas in 1978.

Cultivar	Release date	survey samples
	----year----	-----%-----
Williams	1971	38.0
Columbus	1971	10.3
Clark(s)†	1963	8.2
Forrest	1975	7.1
Cutler(s)†	1971	6.1
Dare	1965	6.1
Pomona	1974	4.5
Essex	1975	3.2
Scott	1958	2.4
Calland	1968	2.6
Woodworth	1974	1.6
York	1967	1.3
Amsoy(s) †	1970	1.1
SRF 450		1.1
Others ‡		6.5

† The original release and disease-resistant counterpart were grouped together (e.g., Clark and Clark 63).

‡ Sixteen other cultivars, each less than 1% of the total cultivars.

Variety	% of Samples	Variety	% of Samples	Variety	% of Samples
Northrup King					
Multivar 72	60.0	Williams	66.7	Williams	67.9
Calland	20.0	Clark(s)	9.1	Cutler(s)	6.4
Amsoy(s)	20.0	Amsoy(s)	9.1	Clark(s)	5.1
	1	Others	15.1 4	Others	20.6 7
Williams	66.6	Williams	62.5	Williams	44.2
Calland	16.7	Columbus	12.5	Clark(s)	16.3
Northrup King		Cutler(s)	12.5	Columbus	13.5
Multivar 72	16.7	Others	12.5	Others	26.0
	2		5		8
Williams	40.0	Williams	41.2	Forrest	19.8
Columbus	13.3	Cutler(s)	17.6	Dare	18.3
Cutler(s)	6.7	Calland	17.6	Columbus	15.9
Others	40.0	Others	23.6	Others	46.0
	3		6		9

Fig. 6. Soybean cultivar distribution by CRD.

Table 7. Acres planted per sampled soybean cultivar per farm sampled.

Area of Kansas	Mean	Std. dev.	Range
	<hr/> acres <hr/>		
Western third	105.8	162.3	8 - 800
Central third	112.0	132.6	7 - 800
Eastern third	147.4	157.2	5 - 1000

Total Acres	% of Samples	Total Acres	% of Samples	Total Acres	% of Samples
1 - 25	0.0	1 - 25	9.1	1 - 25	5.8
26 - 50	0.0	26 - 50	9.1	26 - 50	7.2
51 - 100	60.0	51 - 100	27.3	51 - 100	24.6
101 - 200	40.0	101 - 200	27.3	101 - 200	37.7
201 - 400	0.0	201 - 400	27.3	201 - 400	13.0
>400	0.0	>400	0.0	>400	11.6
1		4		7	
1 - 25	16.7	1 - 25	6.7	1 - 25	2.3
26 - 50	0.0	26 - 50	20.0	26 - 50	10.3
51 - 100	66.7	51 - 100	26.7	51 - 100	19.5
101 - 200	0.0	101 - 200	33.3	101 - 200	32.2
201 - 400	16.7	201 - 400	0.0	201 - 400	23.0
>400	0.0	>400	13.3	>400	12.6
2		5		8	
1 - 25	15.4	1 - 25	12.5	1 - 25	3.1
26 - 50	7.7	26 - 50	12.5	26 - 50	5.2
51 - 100	38.5	51 - 100	12.5	51 - 100	10.3
101 - 200	15.4	101 - 200	31.3	101 - 200	24.7
201 - 400	7.7	201 - 400	25.0	201 - 400	27.8
>400	15.4	>400	6.2	>400	28.9
3		6		9	

Fig. 7. Percent of farms by CRD that have total acreage within a given size limit.

acres (Fig. 7) and larger number of farms (Fig. 5).

Seventeen percent of the samples were from farms that irrigated and 87% were from farms that grew non-irrigated soybeans. The 4% overlap was from farms that produced soybeans under both regimes.

Homegrown seed usage increased from the west to the southeast (Fig. 8). In the eastern two-thirds of the state most farmers plant their own seed rather than purchase seed from a seed dealer or another farmer. In the western third of Kansas where soybean production is just beginning and soybean acreages are low, more seed was purchased through a dealer.

The percentages of dealer and homegrown seed of samples that were correctly identified as to reported cultivar were similar (Table 8). Seed acquired from another farmer was more likely to be 'mixed' than was seed from other sources (Table 8). Clark(s), the oldest cultivar, was the most contaminated cultivar.

The use of inoculants (Rhizobium japonicum) for nodulation decreased from central to eastern Kansas (Fig. 9). Soybeans have been grown in the east longer than most other places in the state so adequate populations of Rhizobium japonicum are present in the soil.

Only 0.3% of the seed samples had detectable fungicide. A pre-plant fungicide treatment could have been applied on the 9.7% samples that reported that a fungicide was applied to the seed, but wasn't applied at sampling.

Only 22.9% of the farmers tested their soils before planting the soybean seed. The pH of the tested soil ranged from 5.3 to 7.7. The pH extremes may cause toxicities or deficiencies of some nutrients although more factors need to be known to make a proper determination (6).

Seed Source	% of Samples	Seed Source	% of Samples	Seed Source	% of Samples
Homegrown Another Farmer Dealer	40.0 0.0 60.0 1	Homegrown Another Farmer Dealer	50.0 16.7 33.3 4	Homegrown Another Farmer Dealer	70.5 7.7 21.8 7
Homegrown Another Farmer Dealer	33.3 16.7 50.0 2	Homegrown Another Farmer Dealer	56.2 6.2 37.5 5	Homegrown Another Farmer Dealer	71.4 16.2 12.4 8
Homegrown Another Farmer Dealer	26.7 13.3 60.0 3	Homegrown Another Farmer Dealer	58.8 17.6 23.5 6	Homegrown Another Farmer Dealer	76.0 11.2 12.8 9

Fig. 8. Source of soybean seed used by Kansas farmers sampled; by CRD.

Table 8. Cultivar purity classified among seed sources and among classes of seed identification.

	Correctly identified	Mixture	Incorrectly identified
	<hr/> %		
Overall	83.4	12.1	4.5
Seed source			
Dealer	85.3	9.3	5.3
Another farmer	76.1	17.4	6.5
Home grown	84.1	12.0	3.9
Seed certification			
Certified	88.9	6.9	4.2
Foundation class	100.0	0.0	0.0
Registered class	90.0	0.0	10.0
Certified class	87.3	9.1	3.6
Non-certified	82.3	12.9	4.9

Treatment	% of Samples	Treatment	% of Samples	Treatment	% of Samples
Inoculated	80.0	Inoculated	91.7	Inoculated	77.6
	1		4		7
Inoculated	66.7	Inoculated	93.8	Inoculated	61.9
	2		5		8
Inoculated	93.3	Inoculated	94.1	Inoculated	67.7
	3		6		9

Fig. 9. Soybean seed samples inoculated with *Rhizobium japonicum* by CRD.

The mean of the soil pH was 6.5, which is satisfactory (6).

Phosphorous tests ranged from 6 to 60 ppm with an average of 25.5 ppm. Potassium tests ranged from 95 to 550+ ppm exchangeable potassium. Phosphorous availability ranged from very low to high and potassium availability ranged from low to very high (26).

Nitrogen, phosphorous, and potassium fertilizers were applied at rates up to 111.5 kg N, 116.0 kg P_2O_5 and 89.2 kg K_2O per hectare. Of the farmers that responded to this question, 69.3% didn't fertilize with nitrogen, 62.5% didn't use phosphorous, and 70.9% didn't fertilize with potassium.

Herbicides were used by 91.9% of the farmers on their soybean crop. Treflan, Sencor, Lexone, and Lasso made up the majority of the herbicides used with soybeans (Table 9). Treflan with Sencor was the most popular herbicide combination. Treflan was the most popular herbicide used alone or in combination.

Most (90.5%) of the soybean seed lots were cleaned. Commercial establishments cleaned 82.9% of the seed that was cleaned, or 75% of the total samples (Fig. 10). This value was similar to the 78.4% of the samples that were free of weed seed and 78.6% of the samples that were free of other crop seed. Farmers traveled up to 150 miles to clean their soybean seed, but the average distance traveled to the cleaner was 15 miles.

The predominant seeding rates (61%) were between 50 and 60 pounds per acre. A significant exception occurred in CRD 9 where the mean seeding rate was 44.1 pounds per acre. The average seed populations, not significantly different in any CRD, was between 344,400 seeds to 387,500 seeds per hectare (8 seeds to 9 seed per row foot in 30-inch

Table 9. Predominant herbicides used by Kansas farmers on soybeans.

Herbicide	Farmers that use herbicides -----%-----	
Trifluralin (Treflan), alone	22.8	
Trifluralin with metribuzin (Sencor or Lexone)	29.0	
Trifluralin, alone or in a combination	58.4	
Alachlor (Lasso), alone	6.2	
Alachlor with metribuzin	11.5	
Alachlor, alone or in a combination	24.9	
Alachlor, Metribuzin, and Trifluralin alone or in a combination	84.5	

% of Samples		% of Samples		% of Samples	
Cleaned Commercial Another Farmer Home Not cleaned	100.0 100.0 0.0 0.0 0.0	Cleaned Commercial Another Farmer Home Not cleaned	100.0 90.9 9.1 0.0 0.0	Cleaned Commercial Another Farmer Home Not cleaned	93.6 75.5 1.3 16.8 6.4
	1		4		7
Cleaned Commercial Another Farmer Home Not cleaned	66.7 66.7 0.0 0.0 33.3	Cleaned Commercial Another Farmer Home Not cleaned	93.8 65.0 7.2 21.6 6.2	Cleaned Commercial Another Farmer Home Not cleaned	89.5 71.6 1.0 16.0 10.5
	2		5		8
Cleaned Commercial Another Farmer Home Not cleaned	92.3 77.8 0.0 15.5 7.7	Cleaned Commercial Another Farmer Home Not cleaned	87.5 75.9 5.8 5.8 12.5	Cleaned Commercial Another Farmer Home Not cleaned	88.8 76.1 1.6 11.1 11.2
	3		6		9

Fig. 10. Soybean seed cleaned, at various locations, vs. not cleaned; by CRD.

rows). With the lower seeding rate in CRD 9 but with the same seed population as other CRD's, farmers, seem to adjust seeding rates to compensate for seed size differences. A correlation of 0.52 between seed weight and seeding rate also tends to support this.

Seed weight (i.e. seed size) varied by a factor of 2.2 (Table 2). Seed population could also vary by the same factor given equal seeding rates. The seeding rate of farmers varied from 159,500 seeds to 602,600 seeds per hectare (3.7 seeds to 14 seeds per row foot in 30-inch rows). The average seeding rate (Table 10) was lower than the suggested seed population in the Soybean Handbook (5), but not all seeds emerged either. Plant populations vary depending on the number of live seed planted and the environmental conditions during emergence (Table 10). Plant populations on the farms ranged from 10,300 plants to 459,500 plants per hectare (.2 plants to 10.7 plants per row foot in 30-inch rows). The average plant population (Table 10) was also lower than the suggested density (5). But, this is not below the populations that would cause yield decreases, given that all other factors, such as weeds, were controlled. Soybeans can compensate very well, but plants in thin stands branch more and pod lower than a denser stand (1). This can increase machine harvest loss. Plants in thinner stands cannot compete against weeds and other crop plants as well as a more dense stand (25). Too dense of a stand can cause thin stems, increased lodging and inflate seed costs (1,18).

Row spacings ranged from 18 cm (7 inches) to 102 cm (40 inches); 63.4% of the farmers used 76 cm (30-inch) row width. Irrigation method and tillage machinery dictate row widths (5). Expense of new

Table 10. Seeding rates and plant populations reported by Kansas farmers.

	Mean	Std. dev.	Range
Seeding rates	354,700	66,000	159,500 - 602,600
Emergence - plant population†	232,500	59,500	10,300 - 459,500
Germination - plant population†	309,800	65,300	59,700 - 530,300
Accelerated aging - plant population†	223,000	99,000	0 - 476,100

† emergence, standard warm germination and accelerated aging percentages respectively were used to estimate the different possibilities for plant populations.

equipment for different row widths may offset any potential yield increase. Weed control is an important factor in considering row width changes (19).

The earliest date on which soybeans can be planted is determined by soil temperature. Optimum planting date is determined by moisture supply, moisture distribution patterns, and cultivar as well as soil temperature (5). Earlier planting dates are usually better because the beans are able to utilize a longer growing season. Other factors, like predicted dry periods, may alter seeding date. For example, seeding date is sometimes used to move the soybean reproductive growth into more favorable weather periods.

Planting in Kansas, on average, began in the southwest, proceeded to the northwest, and then progressed to the southeast part of Kansas (Fig. 11). The statewide average of the seeding date for farmers that didn't double crop soybeans was 2 June. Only 8.3% of the soybean samples were planted as a double crop after cereals. Of these cereals, 95% were wheat with the remainder oats. The seeding date average for soybeans planted as a double crop was 9 June. The large range in seeding dates and the small number of farms that double cropped may give an average date not representative of the actual seeding dates.

Only 51.5% of the farmers had their seed laboratory tested. The reported warm germination mean was 89.6%. Some farmers used seed that tested 75% by warm germination. The best reported germination was 98%. The mean of the reported mechanical purity was 98.32% with a range of 90.00 to 99.99%.

Twenty percent of the samples were of certified seed (Table 11),

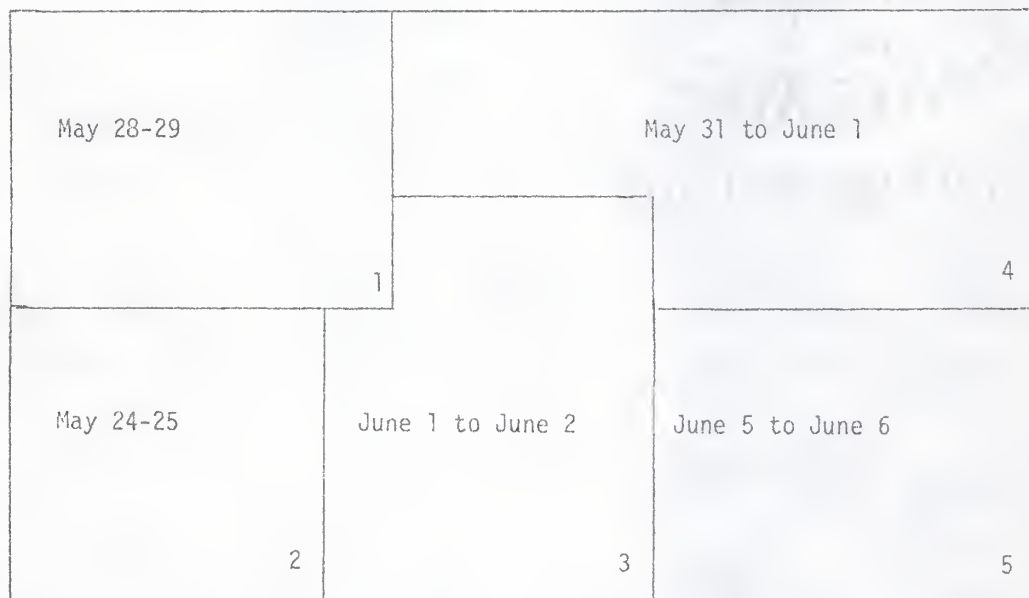


Fig. 11. Seeding date averages of sampled farms by Cooperative Extension Districts.

Table 11. Soybean seed samples that were certified in Kansas, 1978.

	% of Samples
Certified	20.0
Certified class	15.3
Registered class	2.8
Foundation class	1.9
Not certified	80.0

while 86.8% of the farmers used seed within three years of certification. This indicates the concern of the farmers for pure seed and new cultivars.

Properly grown soybean seed that is not certified can be as pure as certified seed (Table 8). The money saved by using homegrown seed may be diminished by the storage, cleaning, testing and treating expense. The use of certified seed will eliminate cost and trouble of maintaining good quality soybean seed, usually for a reasonable price. Certified seed is a low risk seed. It is of a known cultivar, inspected, and tested to insure high quality. However, mistakes can occur (Table 8).

The average number of years from certification decreased from southeast to northwest (Fig. 12). The percentage of certified seed increased from southeast to northwest (Fig. 12). Distribution of the percentage of dealer seed (Fig. 8) was similar to that of the certified seed (Fig. 12) indicating that certified seed was usually sold by a dealer.

Avg. yrs. from certification	0.6	Avg. yrs. from certification	1.9	Avg. yrs. from certification	1.7
	% Certified Seed		% Certified Seed		% Certified Seed
	60.0		41.7		22.5
	1		4		7
Avg. yrs. from certification	0.8	Avg. yrs. from certification	0.9	Avg. yrs. from certification	2.1
	% Certified Seed		% Certified Seed		% Certified Seed
	50.0		37.5		13.6
	2		5		8
Avg. yrs. from certification	0.7	Avg. yrs. from certification	1.2	Avg. yrs. from certification	2.6
	% Certified Seed		% Certified Seed		% Certified Seed
	57.0		35.3		9.4
	3		6		9

Fig. 12. Average number of years from certification and percent certified seed of the soybean seed sampled within each CRD.

SUMMARY AND CONCLUSIONS

Soybean samples collected in the survey corresponded well with soybean acreage in each district. Crop reporting district means of germination, as well as accelerated aging, field test emergence, and mechanical purity were not significantly different and showed no trends across Kansas. Some seed samples were contaminated with weed seeds. Many seed samples did not meet minimum certification standards because they were not properly cleaned. Warm germination and accelerated aging were correlated with field emergence. Mechanical purity, inert matter, and split and broken seed scores were also related but to a lesser degree. Seed analysis performed at the Kansas State Seed Testing Laboratory are useful in determining relative seed quality to make judgements about planting. No significant differences in yield were detected in the yield test, since the plant population required to significantly decrease yields was not reached. Seed quality can make a difference in plant population and may reduce yield.

Williams was the predominant cultivar. Cultivar distribution corresponded to areas in which they were better adapted. Total acres of soybeans is largest in southeast Kansas. More soybeans were grown under non-irrigated conditions than irrigated conditions. Only 22.9% of the farmers tested their soil. The soil tests indicated some problems in pH and nutrient availability. Treflan was the most common herbicide for soybeans, either alone or in combination with another herbicide. Most (90.5%) of the seed samples were cleaned, but, as stated before, the seed needs to be cleaned better to compare to

certified seed. Seeding rates were modified to compensate for seed size differences. Plant populations were lower than the suggested populations. A few farmers would have suffered yield reductions due just to thin plant populations. Only 51.5% of the soybean farmers had their seed laboratory tested. Twenty percent of the samples were of certified seed. Average years from certification was greatest in southeast Kansas. Homegrown seed can be as good as certified seed, however the money saved by using homegrown seed may be diminished by the storage, cleaning, testing, and treating expense.

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KANSAS SOYBEAN SEED SURVEY, 1978

by

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1979

ABSTRACT

A survey was conducted to evaluate the quality of soybean seed planted by Kansas farmers and to determine, along with related factors in production, the significance of the prevalent seed quality.

In cooperation with area extension agronomists, county agricultural agents, and the Kansas State Seed Testing Laboratory, 379 samples of soybean seed collected proportional to soybean acreages and number of soybean farms in the state were analyzed for seed quality to determine its effect on stand establishment and yield.

Soybean samples collected in the survey corresponded with soybean acreages in each district. Many seed samples did not meet minimum certification standards because they were not properly cleaned. Warm germination and accelerated aging were correlated with field emergence. Mechanical purity and related tests were also related to field emergence but to a lesser degree. Seed analysis performed at the Kansas State Seed Testing Laboratory are useful in determining relative seed quality to make judgements about planting. No significant differences in yield were detected in the yield test since the plant population required to reduce the yield was not reached.

Williams was the predominant cultivar. Cultivar distribution corresponded to areas in which they were better adapted. Most (90.5%) of the seed samples were cleaned, but they need to be cleaned better to compare with certified seed standards. Seeding rates were modified to compensate for seed size differences. Plant populations were lower than the suggested populations. Some farmers even had plant populations low enough to cause yield reductions. Only 51.5% of the soybean

farmers had their seed laboratory tested. Twenty percent of the samples were of certified seed. Homegrown seed can be as good as certified seed, however the money saved by using homegrown seed may be diminished by storage, cleaning, testing, and treating expense.